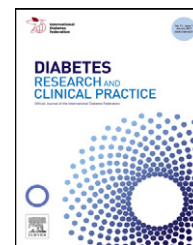




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Commentary

Stand up for your health: Is it time to rethink the physical activity paradigm?

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ABSTRACT

The area of physical activity and health research has been energised by the creation of a new paradigm: sedentary behaviour. Sedentary behaviour and physical activity are increasingly viewed as different constructs with independent effects on the disease process. The creation of the new sedentary behaviour paradigm is likely to have a significant impact on research and interventions aimed at the prevention and management of diabetes in the future. This article highlights the key concepts and implications of this new paradigm.

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Over the last decade the area of physical activity research has been energised by the creation of a new distinctive paradigm: sedentary behaviour. Sedentary behaviour and physical activity, traditionally thought to be two sides to the same coin, are now viewed as different constructs with independent effects on the disease process [1,2]. The creation of the new sedentary behaviour paradigm is likely to have a significant impact on research, policies and public health strategies aimed at the prevention and management of diabetes in the future. This article aims to highlight the key concepts and implications of this new paradigm.

1. What is meant by sedentary behaviour

Various technical definitions of sedentary behaviour have been used, the most common being a metabolic equivalent (MET) of 1.5 or less [3]. However, the origins of the word “sedentary” hint at a simpler, more workable definition. The word sedentary derives from the Latin verb *sedere*—to sit. When sitting or lying, the majority of the body’s largest muscle groups are under relaxation; in contrast, when standing, even if still, a large proportion of the body’s

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musculature is under tension. Therefore any non-exercise activity that involves sitting or lying can be considered sedentary. Conversely any standing activity can be considered non-sedentary. This operational definition broadly fits with more technical definitions and is likely to be the focus of any practical intervention.

2. Sedentary behaviour and energy homeostasis

Sedentary behaviour now encompasses the majority of our lives, accounting for 50–70% of our waking day [4,5]. However, even in today's environment with its multifarious energy saving wonders such as e-banking, e-shopping and the “drive-thru”, this still leaves a large proportion of our day engaged in non-sedentary behaviours, the vast majority of which involves standing activity or low-grade ambulation. The energy expenditure associated with this is commonly referred to as non-exercise activity thermogenesis (NEAT) [6]. Supporting the mass of the body in combination with spontaneous movement or low-grade ambulation consumes around 1.5–2.5 times more energy than sitting-based activities and is thought to “switch-on” important metabolic processes [2,7]. Therefore even in those who do not undertake purposeful exercise, significant amounts of calories are consumed by the levels of NEAT still associated with modern life; NEAT is therefore considered fundamentally important in maintaining energy

homeostasis. This concept is illustrated in Fig. 1 where patterns of energy expenditure for four hypothetical lifestyle scenarios are represented; this Figure demonstrates that the theoretical energy expenditure gap between a desk-bound sedentary worker and a worker with a job that requires standing and low grade ambulation, such as a waiter or nurse, could potentially be over 800 kcal/day—equivalent to walking around 8 miles.

3. Does sedentary behaviour explain temporal trends in obesity?

The importance of NEAT in regulating human energy balance may go some way to explaining the paradox that seems to exist when relating levels of physical activity and energy intake to the obesity epidemic. In England, rates of obesity doubled during a period that energy intake reportedly fell [8]. Data from Canada paint an even more puzzling picture; obesity levels more than doubled over the last couple of decades, despite parallel decreases in energy intake and increases in physical activity [9,10]. Although these results could partly be explained by measurement issues, it is interesting to note that, in contrast to the traditional measures of energy regulation, the prevalence of obesity closely mirrors the sales volume of various common energy saving and sedentary behaviour promoting devices [6]. This further suggests that increased sedentary behaviour may be a key driver in the obesity epidemic.

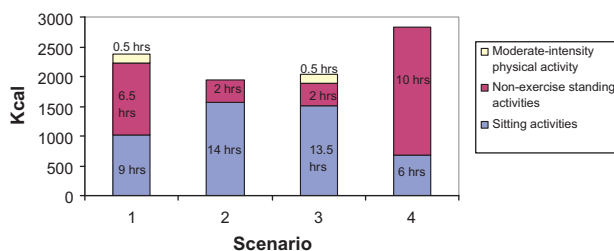


Fig. 1 – Examples of overall and patterns of daily energy expenditure for four typical scenarios. All scenarios are based on a 16 h waking day and a 75 kg person; energy expenditure was calculated from Ainsworth et al. [7]. Scenario 1: Average office worker who meets the physical activity recommendations, accumulating: 9 h of sitting-based activities (average of 1.5 Mets), 6.5 h of non-exercise standing (average of 2.5 Mets), and 30 min of moderate-intensity exercise (4 Mets). Scenario 2: Sedentary office worker, accumulating: 14 h of sitting-based activities (average of 1.5 Mets) and 2 h of non-exercise standing (average of 2.5 Mets). Scenario 3: Sedentary office worker meeting the physical activity recommendations for health, accumulating: 13.5 h of sitting-based activities (average of 1.5 Mets), 2 h of non-exercise standing (average of 2.5 Mets) and 30 min of moderate-intensity exercise (4 Mets). Scenario 4: Active worker (e.g. hospital nurse, factory assembly line worker, waiter), accumulating: 6 h of sitting-based activities (average 1.5 Mets), 7.5 h of work-related standing activities (average of 3 Mets), 2.5 h of other on-exercise standing (average 2.5 Mets).

4. Evidence for the independent effect of sedentary behaviour on health

The field of sedentary behaviour research rests on the premise that it affects the disease process regardless of physical activity. High quality epidemiological research supporting this premise first emerged from the Harvard Medical School at the start of 21st century where TV viewing time was found to be strongly associated with the risk of type 2 diabetes, independently of physical activity [11,12]. This work has been extended by others, particularly by researchers from the Australian Diabetes, Obesity and Lifestyle (AusDiab) study [13,14], and there are now numerous epidemiological studies showing an independent association between sedentary behaviour and the risk of morbidity and mortality in adults [15]. This evidence-base extends to the young; for example, positive associations of sedentary behaviour with markers of metabolic risk and adiposity have been observed in a large European cohort of children and adolescents [16]. Importantly, emerging observational research also suggests that incorporating the recommended amount of physical activity into an otherwise sedentary lifestyle does not fully ameliorate the risks associated with sedentary behaviour [17,18]. Research also suggests that the number of times that sedentary behaviour is broken with bouts of non-sedentary activity is also of importance, particularly in relation to glucose control [4]. Animal models have confirmed that there are probable distinctive physiological pathways linked to sedentary behaviour [2].

5. Moving towards specific recommendations for sedentary behaviour

Despite the current lack of evidence from definitive randomised controlled trials, there is enough accumulated epidemiological evidence to allow for the development of tentative recommendations, such as those recently published in New Zealand [19]. This is likely to be directly relevant to interventions aimed at the prevention of chronic disease, such as type 2 diabetes. For instance, along with traditional messages, such as taking the stairs or walking for transport, which have been the mainstay of physical activity interventions and public health campaigns, individuals also need to be encouraged to substitute a proportion of their sitting time during common leisure activities, such as TV viewing, for standing. Simple strategies could include advocating standing during advert breaks or hiding the remote control.

These findings also need to permeate down to traditional business philosophies, such as that embodied by the widely promoted “Lean Business” approach where human motion is explicitly viewed as “waste”, which has resulted in a workforce increasingly enslaved to their desks and computers. Unlike physical activity, this philosophy is not necessarily mutually exclusive to reducing sedentary behaviour. For example, desks that turn into standing stations would allow for the combination of standing and sitting behaviour. Some have even gone as far as advocating the use of desks linked to treadmills that allow employees to walk slowly whilst carrying out desk related tasks [20].

6. Conclusion

In conclusion, although the importance of physical activity in the prevention and treatment of chronic disease is clear and must remain, there is increasing evidence that it will not offset the deleterious metabolic effects associated with sedentary behaviour. Strategies based on simply sitting less and standing more are therefore expected to revolutionise the health promotion field in the coming years.

Conflict of interest

The authors declare that they have no conflict of interest.

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